sembryanthema; and I found it subsequently at a distant point of False Bay, near "the Strand," and again at Hout Bay. In all these places it was found among plants and bushes growing on sandy dunes near the sea.

July 13, 1849.

XVI.—*On the Chemical Composition of the Fluid in the Ascidia of* Nepenthes. By Dr. A. Voelcker of Frankfort*.

The watery secretions of certain plants belonging to the genera *Nepenthes, Cephalotus,* and *Sarracenia,* have long attracted the attention of botanists; but whilst the secreting organs of these plants have been minutely described, the chemical nature of the fluid itself has been but very imperfectly examined. That these liquids have not met with the attention to which their importance entitles them, may be accounted for by the circumstance that few chemists have an opportunity of obtaining the unaltered fluids, and that even those who are fortunate enough to procure them, seldom can command a sufficient quantity to enable them to investigate their nature. With the exception of Dr. Turner's analysis of the fluid in the ascidia of *Nepenthes,* I know of no other analysis of this fluid or of similar secretions. The botanists who have given attention to the subject of the watery secretions of the leaves of plants have found these secretions to consist in most cases of nothing but pure water, and have only occasionally discovered in them some vegetable matter. Treviranus for instance observed a tasteless water in the corolla of *Maranta gibba,* which he however did not further examine; the same gentleman examined the watery secretion of *Amomum Zerumbet,* and caused Dr. Göppert to subject it to chemical analysis, from which it resulted that the fluid between the scales of the spikes consisted of almost pure water, containing a small quantity of vegetable fibre and mucus.

The most remarkable instance of a watery secretion from the leaves of plants is recorded in the 'Annals of Natural History' for 1848, in a paper by Mr. Williamson, who observed that the leaves of *Caladium destillatorium* had the peculiar power of exhaling watery fluid from a point near the apex on the upper side. Each full-grown healthy leaf, according to Mr. Williamson's observation, produced about half a pint of water during the night, which, on being analysed, was found to contain a very minute portion of vegetable matter.

* Read before the Botanical Society of Edinburgh, July 12, 1849.

It appeared to me highly improbable that these fluid secretions should consist of pure water with merely a trace of vegetable matter, and no inorganic substances whatsoever. If they are to be regarded as true secretions, we naturally should expect them to contain some of the salts which we find in all juices of plants. I was therefore anxious to examine this point, and I am glad that I have an opportunity of bringing the results of my analysis of the fluid in the ascidia of *Nepenthes* before the notice of the Botanical Society. It is through the kindness of Prof. Balfour, Mr. Evans of the Experimental Gardens, Messrs. Jas. Dickson and Sons, and Sir W. Hooker, that I have obtained the materials for the following analysis, and I consider it my duty to express here publicly my deep sense of gratitude for the kindness and liberality with which the above-named gentlemen have assisted me in carrying on this inquiry. I have also to express my obligations to Dr. George Wilson for kindly allowing me the use of his laboratory.

Linnæus regarded the ascidia of *Nepenthes* as a natural reservoir for rain, and thought that the water found in them was introduced from without, and was not secreted by the plant itself. His opinion however has been contradicted already by many botanists, especially Treviranus, who observed that the water in the pitchers of *Nepenthes destillatoria* is always clear, and that there exists a distinct secreting apparatus. Treviranus says, in an article which appeared in the 'Edinb. New Philosoph. Journal' for Oct. 1832—April 1833 :—"The parietes of the leaf of *Nepenthes destillatoria* are traversed by a multitude of proportionally large anastomosing veins, which contain many true spiral vessels. The upper half of its inner surface is covered with a blue rind, as parts often are which require to be protected from the action of water; the under half is, on the contrary, shining and full of gland-like eminences directed downwards, and having a hole almost visible to the naked eye, which is uncovered by the cuticle which the remainder possesses." The watery secretion reaches generally to the level of these glands in the middle of the ascidium, and he thinks that they are true secreting organs. This peculiar structure alone gives a strong reason for thinking that the water in the ascidia of *Nepenthes* is supplied by the plant itself, and the circumstance that water is found in pitchers which have never been opened is another argument against the supposition that it comes from without. The subjoined analysis of the fluid moreover leaves no doubt that it is a true secretion.

Before I enter into the particulars of my experiments I will mention that I could not detect any oxalic acid in the fluid of *Nepenthes*. It is stated in Lindley's 'Vegetable Kingdom' that Dr. Turner found this acid in combination with potash, and that he also detected a trace of organic matter, which caused the watery fluid when boiling to emit an odour of boiled apples. Though I have examined the water of many pitchers from four different localities, and paid particular attention to the detection of oxalic acid, I have failed in finding a trace of it, and I am therefore inclined to believe that Dr. Turner, on account of the minute quantity of solid matter which he must have got on evaporation of the water, was unable to subject the minute crystals which he took for superoxalate of potash to a further examination, which would have shown him that the crystals were not superoxalate of potash, but chloride of potassium. The proportion of chloride of potassium which I found in the fluid is considerable; it is deposited from the liquid after evaporation in the form of minute but very regular cubes. The odour of boiled apples which Dr. Turner observed I found very distinct when the water was heated to the boiling-point. Besides chloride of potassium I found malic and a little citric acid, in combination usually with soda, lime and magnesia, and a small quantity of another organic matter which gave a yellow tint to the water during its evaporation. The quantity of the latter was too minute to enable me to ascertain its chemical nature.

I will now proceed to describe the experiments with the different fluids in the ascidia of *Nepenthes*:—

1. Fluid from an unopened pitcher-plant grown in the Botanical Garden, Edinburgh.

The water which I got on the 12th of June, 1849, was perfectly colourless and clear; it had an agreeable, not very pronounced smell and a refreshing taste. Though its taste was not sour, litmus paper showed the presence of an acid or an acid salt by the red colour it assumed when dipped in the water. When heated it remained clear, and only assumed a slightly yellow colour when the liquid became very concentrated. The residue which remained on evaporation was cream-coloured, very hygroscopic, and dissolved entirely in a small quantity of distilled water. Litmus paper plunged in this solution was turned red immediately; the acid which is present in the water therefore was not volatilized during the evaporation.

The quantity of the water from one pitcher amounted to

17·41 grains,

which gave on evaporation

0·16 of dry residue, dried at 212° F.

100 parts of the fluid consequently contained

0·92 per cent. of solid matter.

2. Water from unopened pitcher-plants grown in the Botanical Garden, Edinburgh, June 13th, 1849.

The physical characters were the same as those of the preceding liquid. Litmus paper likewise was turned red when dipped in the water.

The behaviour of the water towards chemical tests was as follows :—

Ammonia produced no change.

Carbonate of ammonia produced no change.

Lime-water produced no change.

Chloride of calcium and ammonia produced no change.

Nitrate of barytes produced no change.

Nitrate of silver gave a white voluminous precipitate, insoluble in nitric acid, but soluble in ammonia.

Acetate of lead produced a white precipitate soluble for the greater part in boiling water.

Basic acetate of lead gave a white voluminous precipitate in the clear liquid filtered from the precipitate which was caused by neutral acetate of lead.

Oxalate of ammonia produced a small white precipitate of oxalate of lime.

Phosphate of soda and ammonia, added to the concentrated liquid filtered from the oxalate of lime, gave a crystalline white precipitate of phosphate of magnesia and ammonia.

Chloride of platinum, added to the water after having been evaporated to a small bulk, produced a crystalline yellow precipitate.

The residue left on evaporation of the water coloured the alcohol flame yellow.

These reactions indicate the presence of chlorine, potash, soda, magnesia, lime and organic acids, and prove the absence of other bases and of sulphuric acid, tartaric acid, racemic acid, oxalic and phosphoric acid.

3. Fluid from unopened pitcher-plants grown in the Experimental Gardens, Edinburgh, June 13th, 1849.

The water was perfectly clear and colourless, had an acid reaction on litmus paper, and exhibited the same physical and chemical characters as the fluid from the pitcher-plants of the Botanical Garden.

63·21 grains of water left on evaporation a residue which, dried at 212° F., amounted to

0·58 grain.

100 parts of the fluid therefore contained

0·91 per cent. of dry residue.

Exposed to a red heat the residue (0·58 gr.) turned black, and gave off pungent fumes, and left a white ash after all the charcoal was completely burnt away, the weight of which was 0·42 of a grain.

The loss by burning therefore was 25·86 per cent.

The residue left on evaporation of this fluid was slightly coloured, and gave an almost colourless solution with water. A portion of this solution was kept in a closed bottle. After the lapse of a fortnight the water in the bottle became turbid and deposited some light white flakes. The acid reaction, which was very distinct before, had now disappeared entirely.

4. Fluid from opened pitcher-plants grown in the Experimental Gardens, June 14th, 1849.

The fluid in the open pitchers was coloured yellow, but otherwise perfectly clear. The reactions with chemical tests were the same as the preceding.

97·74 grains of water left on evaporation 0·85 of a grain of dry residue.

100 parts therefore contained 0·87 per cent. of solid matter.

This residue was coloured yellow, but redissolved entirely in a little water.

5. Fluid from unopened pitcher-plants grown in Messrs. Dickson's nursery, June 17th, 1849.

Fluid perfectly clear and colourless, reactions the same as above.

319·48 grains left a residue which, dried at 212° F., was found to weigh 1·88 grain; or

100 parts of the liquid contained 0·58 per cent.

6. Liquid from unopened pitcher-plants grown in Messrs. Dickson's nursery, June 21st, 1849.

Physical and chemical characters of the liquid the same as above.

193·82 grains of water left on evaporation 1·22 grain of dry residue, or 0·62 per cent.

When burnt the 1·22 grain lost in weight 0·44 of a grain, or 100 parts of the residue lost 36·06 per cent.

The solid matter of this liquid was very hygroscopic, and coloured more yellow than that of the Botanical and Experimental Gardens. I found that the total weight of the solid matter in this fluid was not so large as in that of the Experimental Gardens, but that the proportion of organic matter in the residue was larger than that in the residue of the fluid procured from the Experimental Gardens.

7. Water from opened pitcher-plants grown in Messrs. Dickson's nursery, June 24th, 1849.

This fluid was yellow-coloured and not quite clear. Litmus paper was turned red when moistened with the water. The reactions were the same as above, with the exception that nitrate of barytes produced a slight turbidity, indicating the presence of sulphuric acid. As I found no sulphuric acid in the liquid from the unopened pitchers of the same plants, nor in any of the liquids I examined, I think the sulphuric acid which I found must have resulted from the water with which the plants had been watered which had found its way into the open pitchers*. In order to see if the liquid contained any volatile acid, I subjected about half an ounce of it to distillation. The distillation was continued till the residue in the glass retort was evaporated to dryness, and the generated steam carefully condensed in a glass receiver. The distilled portion was perfectly pure water, and experienced no change by any reagent.

It results from this experiment that the liquid in the ascidia of *Nepenthes* does not contain any volatile acids, such as acetic or formic acid.

8. Fluid from unopened pitcher-plants grown in the Royal Gardens, Kew.

Having been unable to detect any oxalic acid in the above-mentioned fluids, I was anxious to ascertain whether or not the fluid of plants grown in other localities contained oxalic acid. I therefore applied to Sir W. Hooker, who with great liberality directed some liquid of unopened pitcher-plants grown in the Kew Royal Botanical Gardens to be sent to me. The physical and chemical characters of this fluid were precisely the same as those of the previously examined liquids. The proportion of solid matter it held in solution however was much smaller.

299·87 grains of the liquid left on evaporation only
0·82 of a grain of dry residue.
100 parts of the liquid therefore contained
0·27 per cent. of solid matter.
On burning, the 0·82 of a grain lost 0·27 of a grain, or
100 parts lost 32·92 per cent.

All the liquids from the different localities above-mentioned which were left over I mixed together and evaporated the mixture to dryness. One-half of the dry residue I exposed to a red heat, and used the remaining white ash for the determination of the inorganic salts of which it was composed.

The other half I dissolved in water and precipitated with basic acetate of lead, in order to obtain the organic acids in combination with lead. This precipitate I collected on a filter and washed with cold distilled water. It was then removed from the filter and suspended in water, through which a current of sulphuretted hydrogen was passed. By this means I separated the lead as sulphuret, and obtained the organic acids free dissolved in water. This solution was colourless and very acid; evaporated to a small bulk in a water-bath it assumed a yellow colour, and dried at last to a yellow crystalline mass, which deliquesced in the air and dis-

* The water in this instance was procured chiefly from the Water of Leith.

solved readily in water and alcohol, leaving behind a trace of a brown organic matter.

Lime-water added in excess to a portion of the acid solution produced no precipitate in the cold, but on boiling a small white precipitate fell down which redissolved entirely in sal ammoniac.

Chloride of calcium and ammonium left the liquid unchanged in the cold, but on boiling a precipitate was formed which was soluble in sal ammoniac.

Acetate of lead gave a white precipitate insoluble in ammonia, soluble in acetic acid.

Basic acetate of lead added to the liquid filtered from the precipitate caused by neutral acetate of lead produced another abundant white precipitate. From these reactions it appears that the precipitate with lime-water was caused by citric acid and not by tartaric or racemic acid, the reactions of which acids are similar to those of citric acid, for tartrate of lime is not soluble in sal ammoniac, whilst tartrate of lead redissolves readily in ammonia. Tartaric acid moreover is sufficiently characterized by the sparing solubility of its acid potash salt, and as the acid liquid did not give rise to the formation of such a salt with potash, we have another indirect proof of the presence of citric acid. A little tartaric acid added to the liquid in which tartaric acid was sought in vain, after a few minutes produced the sparingly soluble potash salt.

Racemic acid is thrown down both by lime-water and by a solution of gypsum; the acid liquid of *Nepenthes* remained unchanged by either reagent, hence it cannot have contained any racemic acid.

The precipitate caused by chloride of calcium and ammonia and boiling was filtered hot, and alcohol and ammonia added to the clear liquid. The addition of alcohol produced a voluminous white precipitate, a reaction which indicates the presence of malic acid. The quantity of this precipitate was much larger than that of the lime precipitate which citric acid gave. The formation of a precipitate, upon addition of alcohol to the liquid from which the first had been separated by filtration, is characteristic of the presence of malic acid, for no other lime-salts were present; for instance, no sulphate of lime was present which could have produced a precipitate. But I thought it nevertheless necessary to examine the precipitate caused by the addition of alcohol further. When burnt it turned black, gave off pungent vapours, and was converted into carbonate of lime. The solution of chloride of calcium and ammonia used for the experiment remained clear after the addition of alcohol; the acid liquid likewise remained clear when alcohol was added; both put together immediately produced a white voluminous precipitate.

Basic acetate of lead, as already mentioned, throws down from the solution a white precipitate. I could not observe that this precipitate melted below the boiling-point of water, as pure malate of lead does, but it must be remembered that this reaction is distinctly marked only when the malate of lead is pure; admixtures of other salts of lead prevent it altogether; and as I have shown the presence of citric acid and another organic substance which is thrown down by basic acetate of lead, there can be no doubt that this was the reason why the precipitate did not dissolve in boiling water.

Though I have not been able to obtain a sufficient quantity of the acids of *Nepenthes* for an elementary analysis, I think the above reactions prove the presence of malic and citric acid. Oxalic acid, which is readily detected, as the weakest solution of an oxalate is thrown down by lime-water, I failed to discover; on the contrary, I have shown that the water contained lime, which excludes the coexistence of oxalic acid in a clear liquid. I have found that the smallest quantity of oxalic acid immediately caused the water of *Nepenthes* to become turbid.

The second half of the residue left on evaporation of the mixed fluids I exposed to a red heat in a platinum capsule. It turned black, gave off pungent fumes, and left a white salt after all the charcoal was burnt off.

On analysis this residue was found to consist of

Chloride of potassium	76·31
Carbonate of soda	16·44
Lime	3·94
Magnesia	3·94
	100·63

The unburnt residue left on evaporation of the fluid in the ascidia of *Nepenthes* therefore consists, if we take the average of the loss of the three determinations at 31·61 per cent. and reject the carbonic acid of the ash, of—

Organic matter, chiefly Malic acid and a little citric acid .	38·61
Chloride of potassium	50·42
Soda	6·36
Lime	2·59
Magnesia	2·59
	100·57

It is remarkable that none of the fluids which I examined contained any sulphuric acid, which acid has been found in all juices of plants, and which I do not doubt also exists in the sap of *Nepenthes.* An ash analysis of this interesting plant would show the proportion of sulphuric acid at once; and as we are not in possession of an analysis of the ash of *Nepenthes,* which in other respects might be of interest, I take the liberty of asking those gentlemen who are in the possession of *Nepenthes'* plants to preserve the clippings of branches, &c., which I shall be glad to receive as materials for an ash analysis.

XVII.—*Contributions to the Botany of South America.* By John Miers, Esq., F.R.S., F.L.S.

[Continued from p. 39.]

Margaranthus.

Among the various collections of Mexican and South American plants, I have not been able to find any specimen corresponding with this genus, of which indeed nothing appears to be known, except the description given of it by Prof. Schlechtendal, and the figure drawn by that able botanist from living specimens raised in Halle from seeds received from Mexico. On comparing this with *Physalis* and its allied genera, it will be seen to differ from them in the smaller size and pale blue colour of its flowers, and particularly in the great contraction of the mouth of the corolla, which gives it a globular instead of a campanular form. The calyx is more entire on its margin, and like *Physalis* enlarges, becomes vesicular, and incloses a small globular berry with aqueous juice, which becomes exsuccous. I have here amended its character as contrasted with its allied genera.

Margaranthus, Schl.—*Calyx* urceolato-tubulosus, 5-angularis breviter 5-dentatus, persistens et accrescens. *Corolla* urceolato-globosa, 5-sulcata, imo attenuata, medio ventricosa, ore valde contracta, margine dentibus 5 minutis instructa, intus villosula. *Stamina* 5, æqualia, inclusa, corollæ dimidio breviora; *antheræ* conniventes, 2-lobæ, dorso affixæ, rima duplici longitudinaliter dehiscentes. *Ovarium* globosum, 2-sulcatum, disco carnoso annulari basi immersum, 2-loculare, placentis multiovulatis, medio dissepimenti utrinque adnatis. *Stylus* simplex, apice attenuatus. *Stigma* truncatum. *Bacca* substipitata, 2-locularis, exsucca, pericarpio membranaceo, polysperma, calyce inflato, ovoideo, reticulato-venoso, dentibus ore clauso laxe inclusa. *Semina* orbiculato-reniformia. *Embryo* in *albumen* semipellucidum curvatus.—Herba Mexicana *dichotome ramosa,* foliis *alternis, ovatis, vel ovato-lanceolatis, acutis, petiolatis;* floribus *axillaribus, solitariis, parvulis, pedunculatis, nutantibus, sordide cærulescentibus.*

1. *Margaranthus solanaceus,* Schl. (Hort. Halens. i. tab. 1);—